

CLAIMS

What is claimed is:

- 1 1. A method of substantially continuously optimizing a stochastic parameter
2 \mathcal{G} that characterizes the instantaneously prevailing readiness with which crop is
3 processed in a harvesting machine, including the step of recursively calculating
4 the optimized parameter value in accordance with the following algorithm:

$$5 \quad \hat{\mathcal{G}}(t) = f(\hat{\mathcal{G}}(t-1), \varepsilon(t, \hat{\mathcal{G}}(t-1))) \quad - \text{ (A)}$$

6 wherein:

7 $\hat{\mathcal{G}}(t)$ is the optimized stochastic parameter value at time t ; and

8 $\varepsilon(t, \hat{\mathcal{G}}(t))$ is an error prediction function.

- 1 2. A method according to claim 1, wherein the algorithm (A) has the form:

$$2 \quad \hat{\mathcal{G}}(t) = f(\hat{\mathcal{G}}(t-1), \dots, \hat{\mathcal{G}}(t-n_g), \varepsilon(t), \dots, \varepsilon(t-n_e), t).$$

- 1 3. A method according to Claim 1, wherein the algorithm (A) has the form:

$$3 \quad \hat{\mathcal{G}}(t) = \hat{\mathcal{G}}(t-1) + \gamma(t)r^{-1}(t)\psi(t, \hat{\mathcal{G}}(t-1))\varepsilon(t, \hat{\mathcal{G}}(t-1))$$

5 wherein:

6 $\gamma(t)$ is a gain term;

7 $r(t)$ is a scalar approximation of a Hessian $V''(\mathcal{G})$ in which V is a
8 quadratic error criterion;

$$9 \quad \psi(t, \mathcal{G}) = \frac{d\hat{y}(t, \mathcal{G})}{d\mathcal{G}}, \text{ in which } \hat{y}(t, \mathcal{G}) \text{ is an estimation of a value indicative of}$$

10 the effectiveness of crop processing in said harvesting machine, said estimation
11 being based on stochastic parameter \mathcal{G} ; and

12 $\varepsilon(t, \hat{\mathcal{G}}(t-1))$ is the difference between the actual effectiveness value $y(t)$

13 and the estimated value $\hat{y}(t, \mathcal{G})$ based on the previously optimized parameter

14 $\hat{\mathcal{G}}(t-1)$.

1 4. A method according to Claim 3, wherein the algorithm (A) includes an
2 estimation of $r(t)$ that is weighted to reduce the influence, on the optimized
3 parameter values $\hat{\mathcal{G}}$, of past measurements.

1 5. A method according to Claim 3, wherein:
2 said stochastic parameter \mathcal{G} is usable in a model for the relation between a
3 value $u(t)$ indicative of the feedrate of crop into the harvesting machine and a
4 value $y(t)$ indicative of the effectiveness of an operation processing said crop in
5 said harvesting machine; and
6 said value $\hat{y}(t, \mathcal{G})$ is an estimation value of the effectiveness obtained by
7 the application of said model to the feedrate values $u(t)$.

1 6. A method according to Claim 5, wherein said model comprises an
2 exponential function.

1 7. A method according to Claim 6, wherein said model has the form:
2 $\hat{y}(t, \mathcal{G}) = \exp(\mathcal{G}u(t)) - 1.$ - (B)

1 8. A method according to Claim 5, wherein:
2 said crop processing comprises separating useable crop parts from other
3 plant matter; and
4 said value $y(t)$ is indicative of a flow of useable crop losses in a selected
5 part of the harvesting machine.

1 9. A method according to Claim 5, wherein:
2 said crop processing operation comprises separating useable crop parts
3 from other plant matter; and
4 said value $y(t)$ is indicative of a flow of return crop in a selected part of the
5 harvesting machine.

1 10. A method of operating a harvesting machine comprising the steps of:
2 substantially continuously optimizing a stochastic parameter \mathcal{G} that
3 characterizes the instantaneously prevailing readiness with which the harvesting
4 machine processes crop; and
5 substantially continuously adjusting a performance variable of the

6 harvesting machine in dependence on the instantaneous, optimized value $\hat{\mathcal{G}}$ of
7 said parameter in order to optimize the load of the harvesting machine so as to
8 keep a value $y(t)$ indicative of the effectiveness of said harvesting machine below
9 a predetermined value.

1 11. A method according to Claim 10, wherein:
2 processing the crop comprises separating useable crop parts from other
3 plant matter;
4 optimizing the load of the harvesting machine comprises optimizing the
5 feedrate $u(t)$ of crop into the harvesting machine; and
6 the effectiveness value comprises losses $y(t)$ of useable crop parts.

1 12. A method according to Claim 10, wherein the step of continuously
2 optimizing a stochastic parameter \mathcal{G} includes carrying out the method steps of
3 Claim 1.

1 13. A method according to Claim 10, wherein the step of adjusting a
2 performance variable of the harvesting machine occurs in dependence on the
3 output of an inverted form of a yield loss estimation function:

4
$$\hat{y}(t, \mathcal{G}) = \exp(\mathcal{G}u(t)) - 1. \quad - (B)$$

1 14. A method according to Claim 10, wherein adjusting a performance
2 variable comprises adjusting the travel speed of said harvesting machine or the
3 actual cutting width of a header of said harvesting machine.

1 15. A method of mapping one or more field lots for variations in a stochastic
2 parameter \mathcal{G} that characterizes the instantaneously prevailing readiness with
3 which crop is processed in a harvesting machine, the method comprising the steps
4 of:

5 operating a harvesting machine to harvest crop in a field lot;
6 simultaneously measuring the machine load and the machine effectiveness
7 and determining the position of the machine in the field lot;
8 storing data indicative of the position of the harvesting machine at time t ;
9 using the measured machine load data $u(t)$, and machine effectiveness data
10 $y(t)$ in an optimization of said parameter \mathcal{G} ; and

11 mapping the optimized parameter values $\hat{\mathcal{G}}$ obtained from the step of
12 using the measured machine load data $u(t)$ and machine effectiveness data $y(t)$ in
13 an optimization of said parameter \mathcal{G} ; so as to produce a parameter map of the
14 field lot.

1 16. A method according to Claim 15, wherein the step of using the measured
2 machine load data $u(t)$, and machine effectiveness data $y(t)$ in an optimization of
3 said parameter \mathcal{G} includes carrying out an optimization according to Claim 1.

1 17. A method of operating a harvesting machine comprising the steps of:
2 substantially continuously optimizing a stochastic parameter \mathcal{G} that
3 characterizes the instantaneously prevailing readiness with which the harvesting
4 machine separates useable crop parts from other plant matter; and
5 sending a display signal, that is indicative of the instantaneous parameter
6 value $\hat{\mathcal{G}}$, to a display device.

1 18. A method according to Claim 17, wherein the step of optimizing a
2 stochastic parameter \mathcal{G} includes carrying out the method of Claim 1.

1 19. A method according to Claim 17, wherein the display signal indicates an
2 abnormal parameter value $\hat{\mathcal{G}}$.

1 20. A methods according to Claim 1, wherein said harvesting machine is a
2 combine harvester and the crop is a grain-bearing plant.

1 21. A method according to Claim 8, wherein said selected part of the
2 harvesting machine is:
3 the straw walkers;
4 the rotary separator;
5 the sieves;
6 the grain elevator;
7 the return flow system;
8 the cleaning section; or
9 the axial threshing and separating rotor;
10 of a combine harvester.